

R20 Transfer Line Optics Study using 1-Bump Orbits

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10/19/06

Agenda

❖ R20 beamline optics study

- ▶ Study has never been done.
 - Need 2.5 MHz BPM system

❖ Lambertson field errors

- ▶ Lam214 in RR
- ▶ Lam222 in MI.

❖ Transfer matching

- ▶ Lattice
- ▶ Dispersion

Data

❖ Closed bump across RR Lam214

- ▶ Keep RR closed orbit fixed.
- ▶ 1-bump orbit for proton to MI.
- ▶ Horizontal data
 - with H204 & H206.
- ▶ Vertical data
 - with V203 & V205

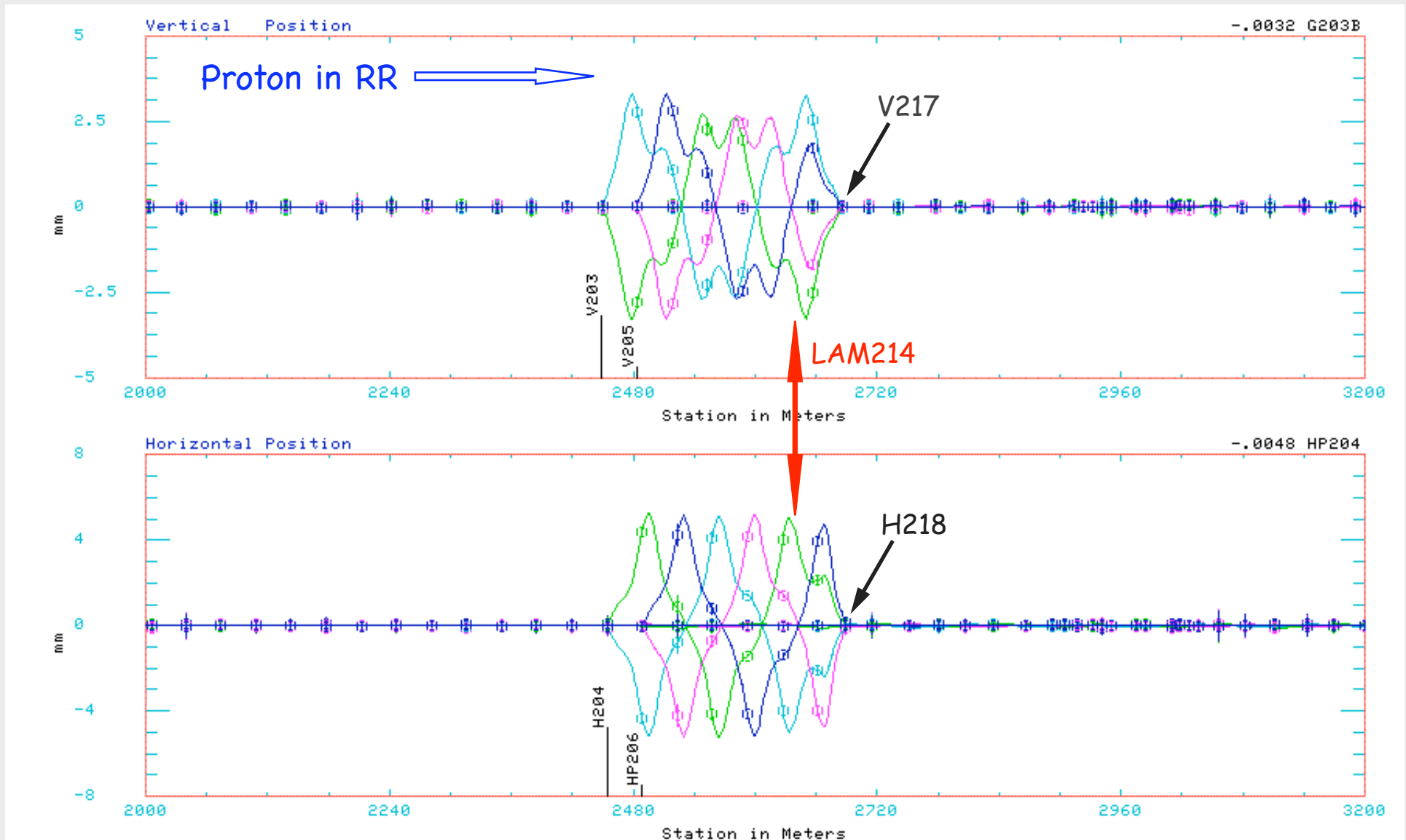
❖ Included BPM data:

- ▶ RR last turn,
- ▶ R22 line,
- ▶ MI first turn.

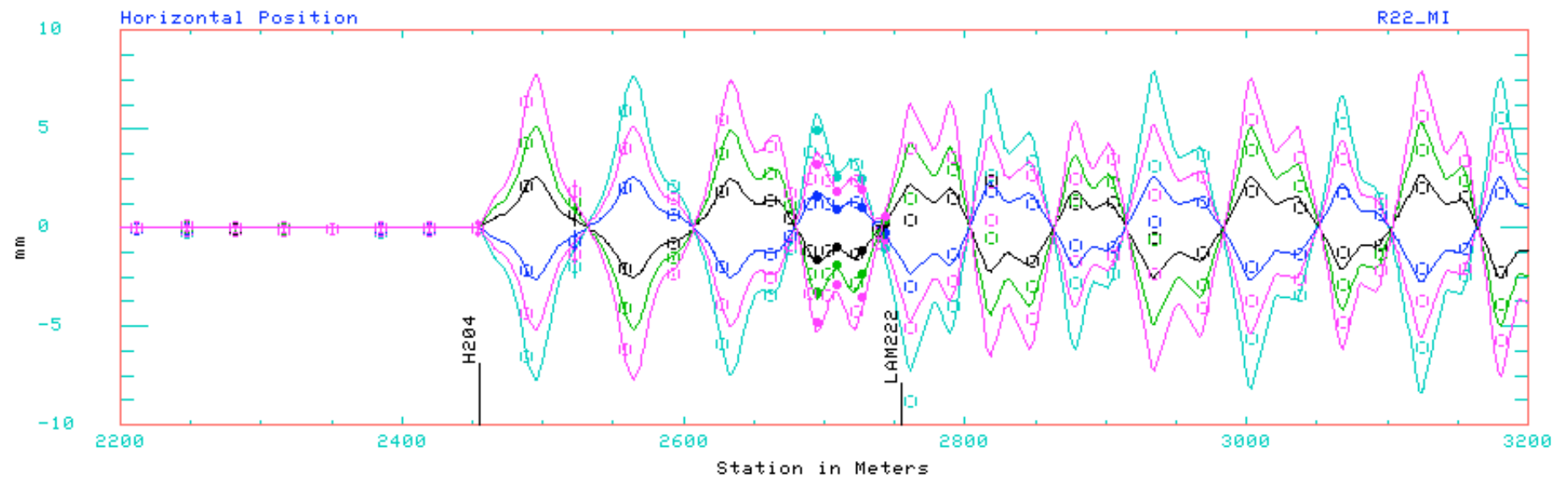
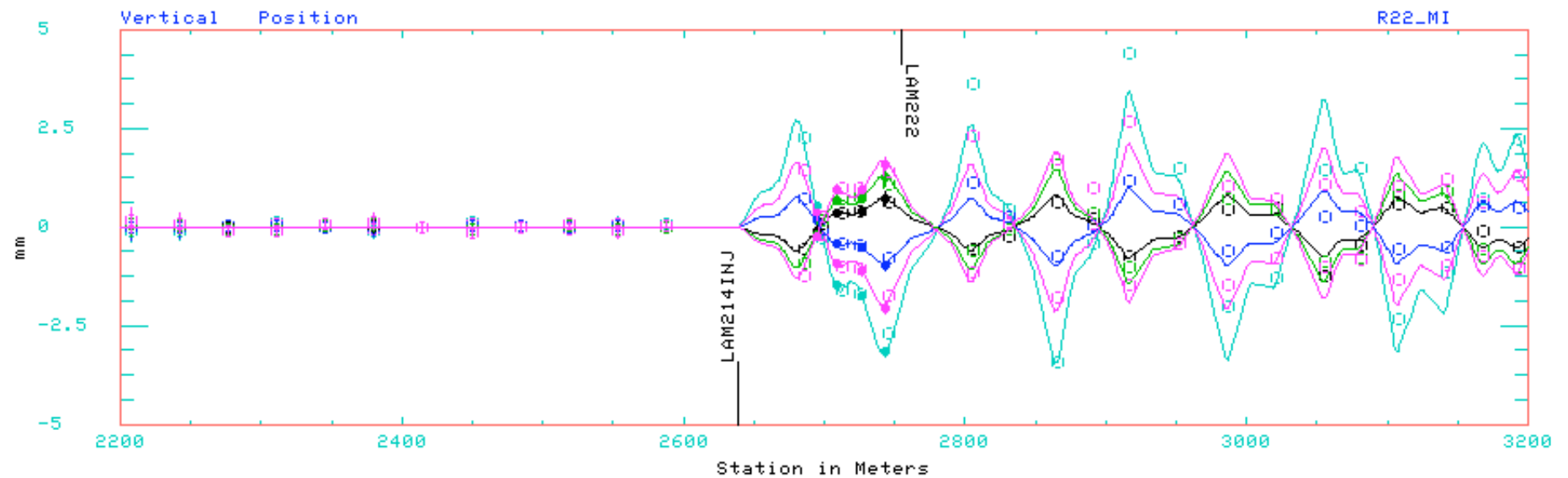
❖ Beam intensity

- ▶ 2 Booster turns and 5 bunches.

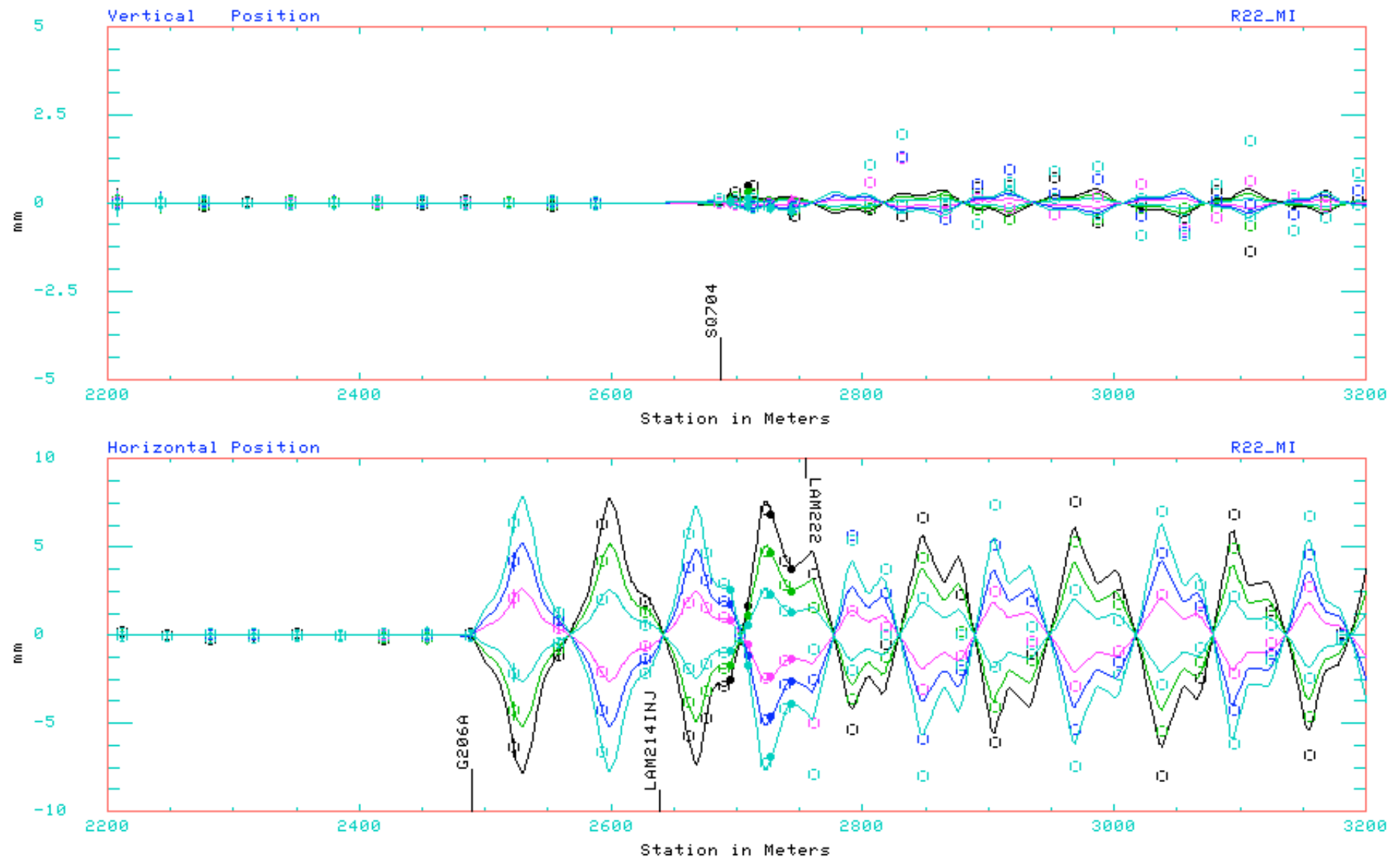
Closed long bumps across RR LAM214



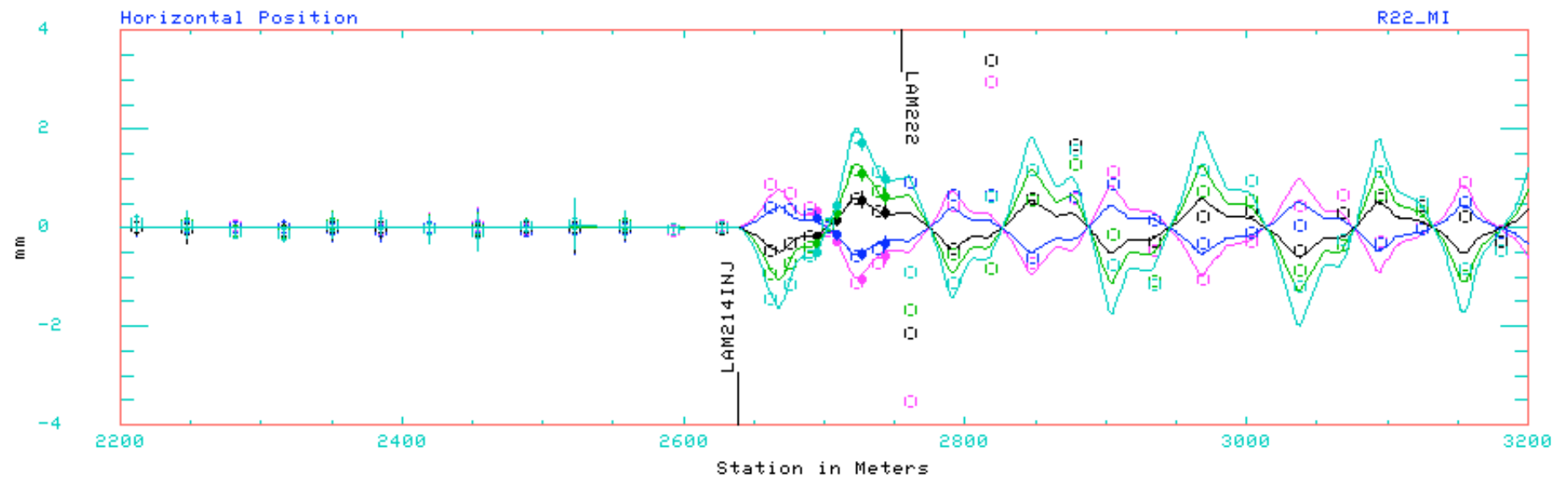
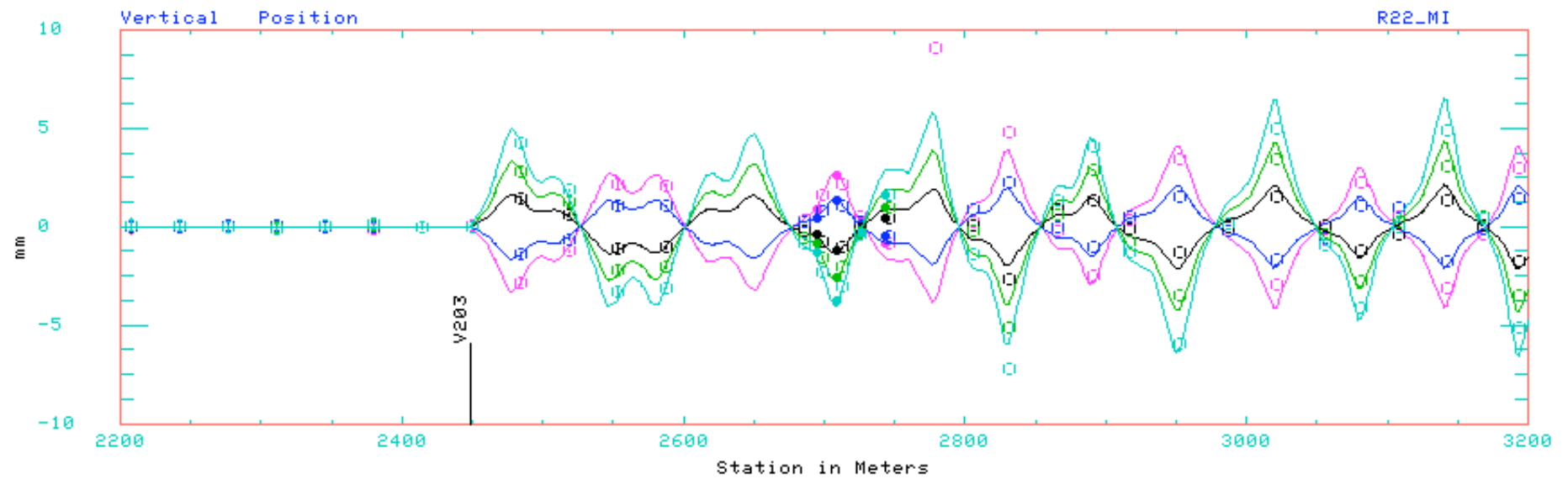
RR to MI horizontal data, H204



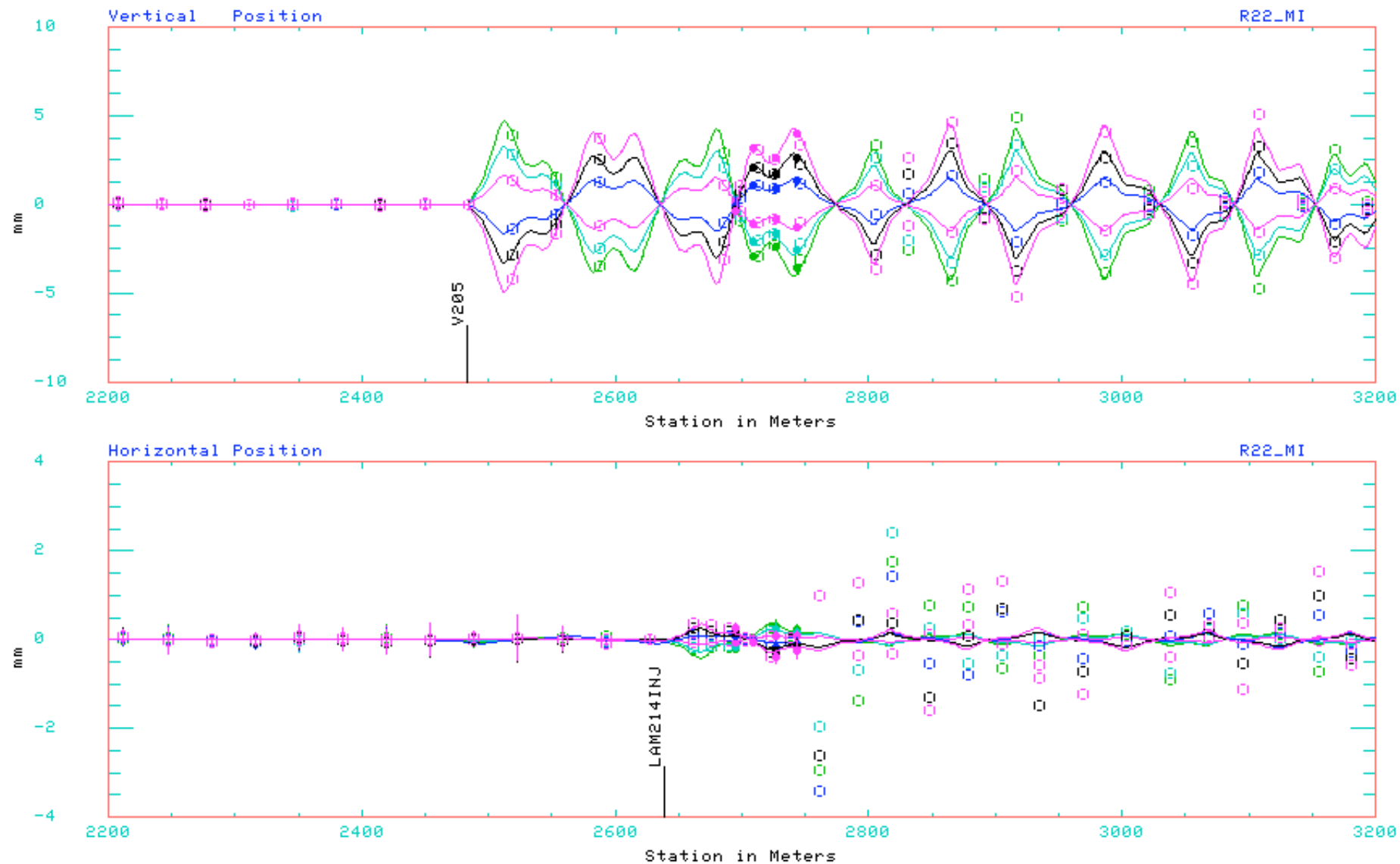
RR to MI horizontal data, H206



RR to MI vertical data, V203

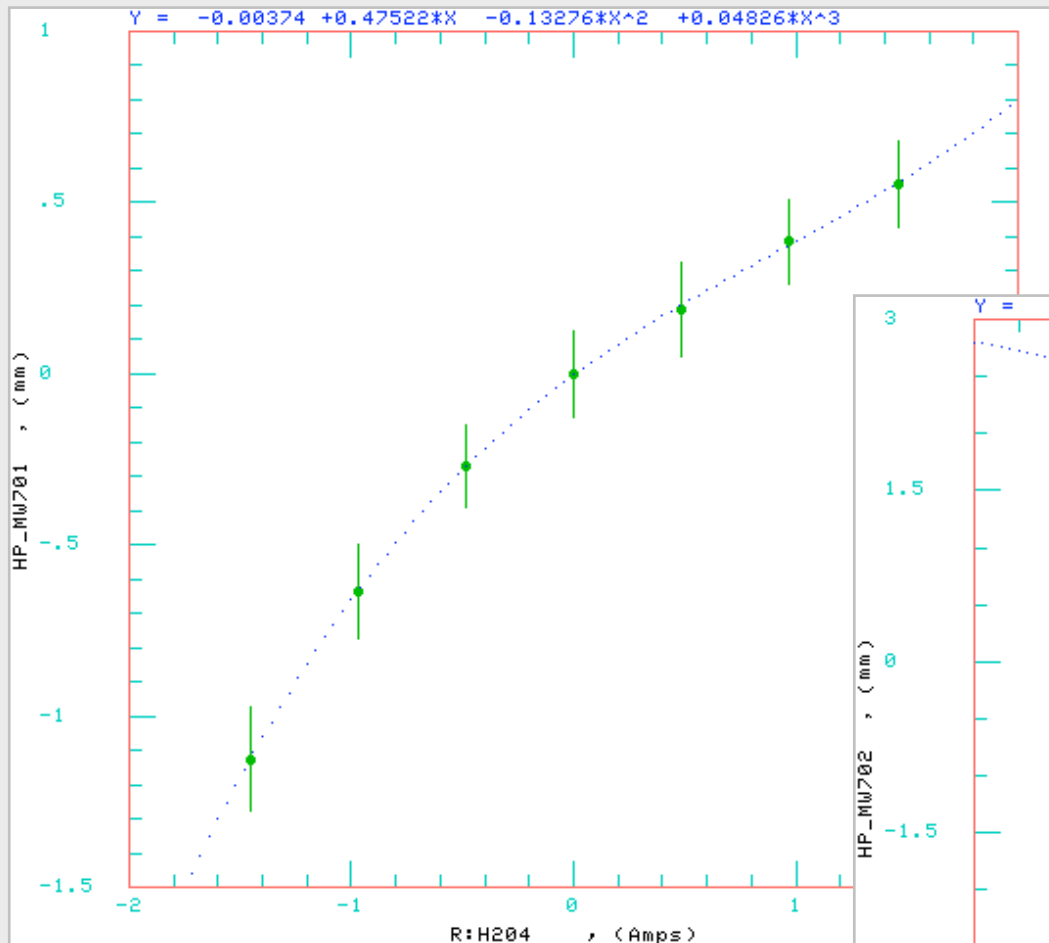


RR to MI vertical data, V205

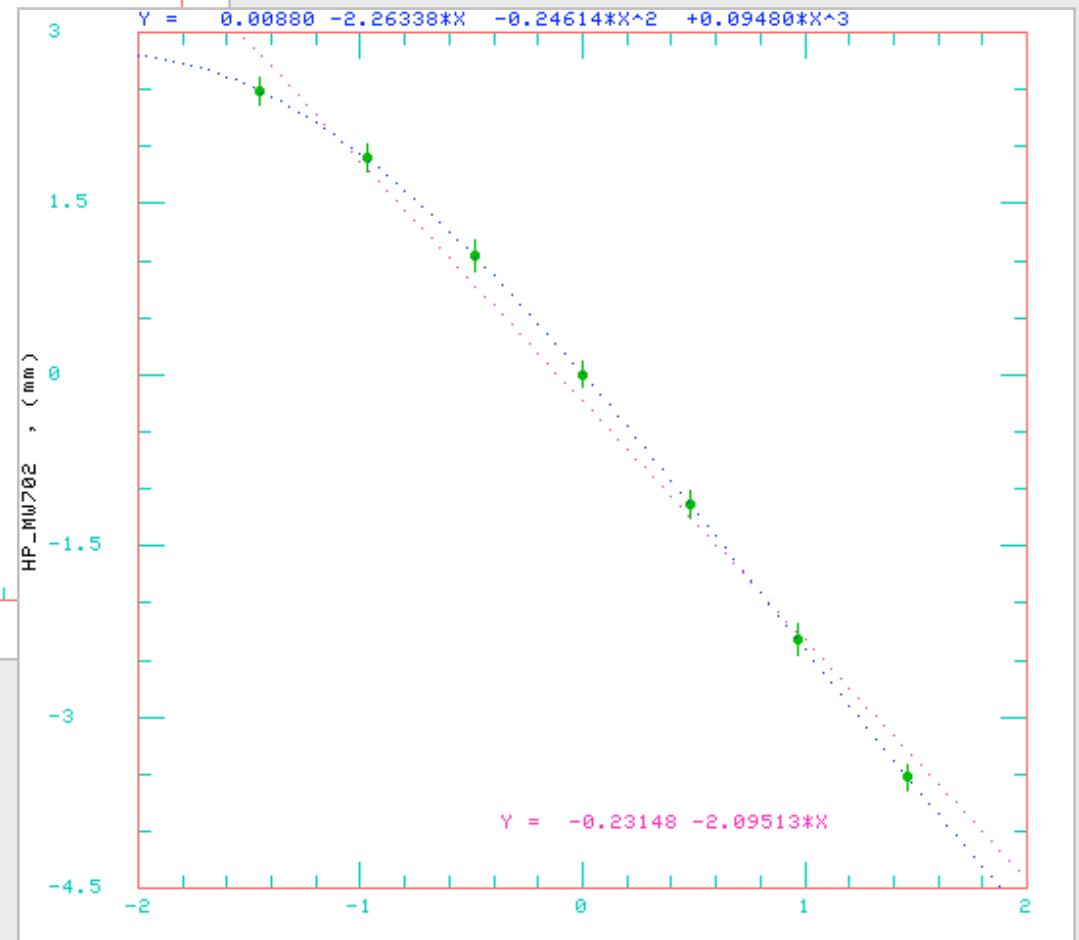


Position data example, horizontal

MW701 horizontal

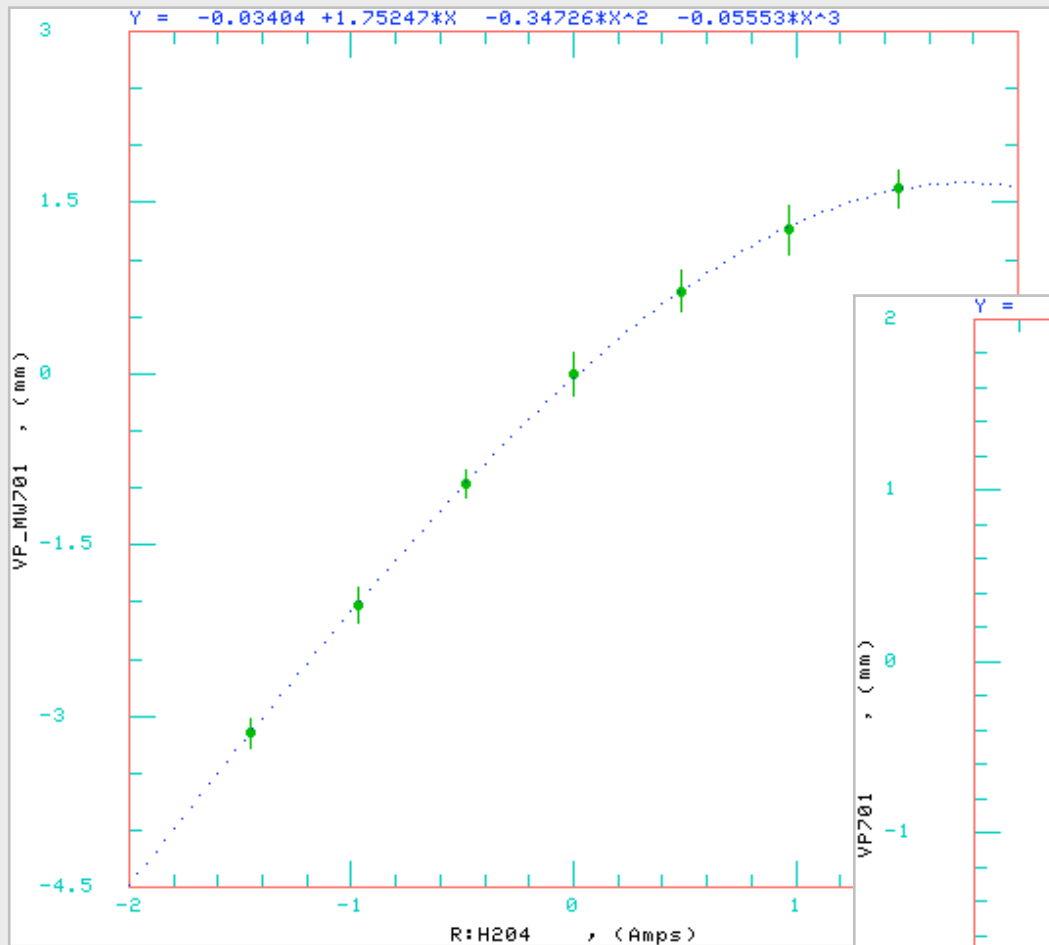


MW702 horizontal with
3rd & 1st order fit

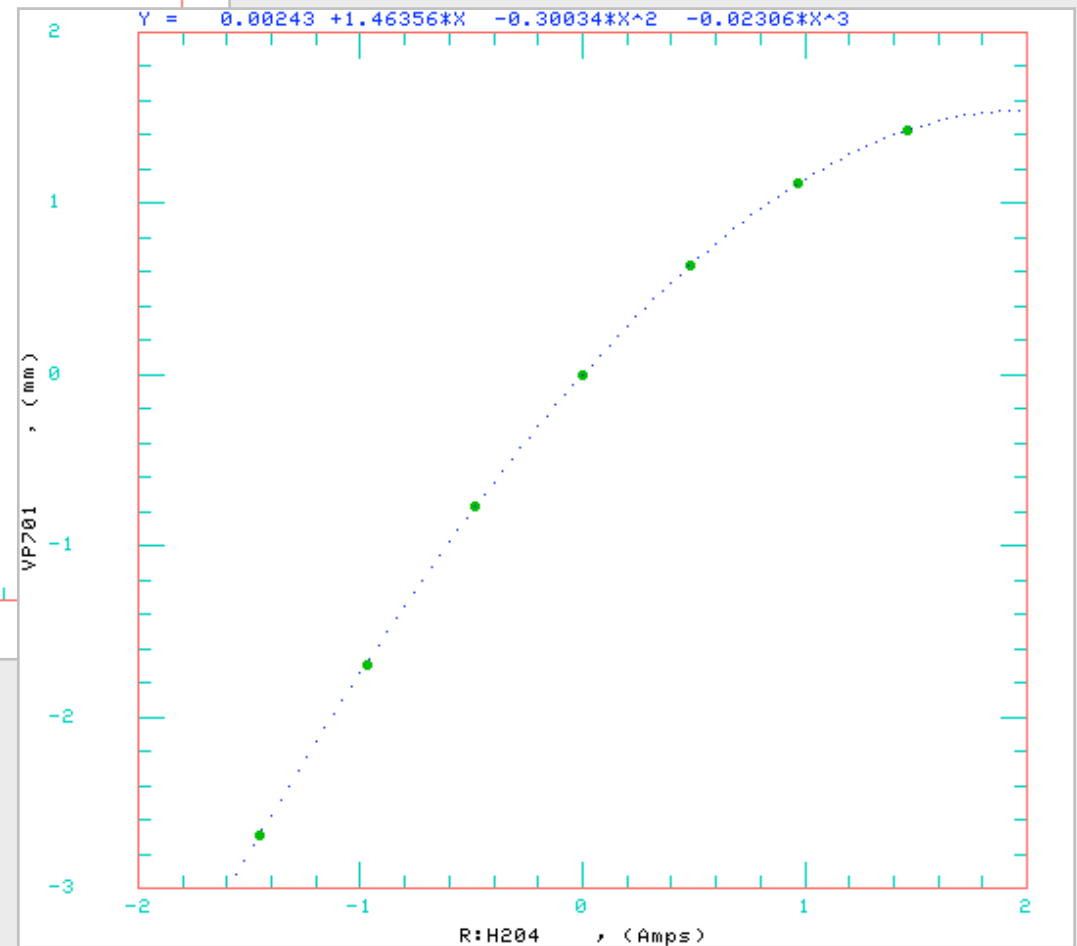


Position data example, vertical

MW701 vertical



BPM VP701



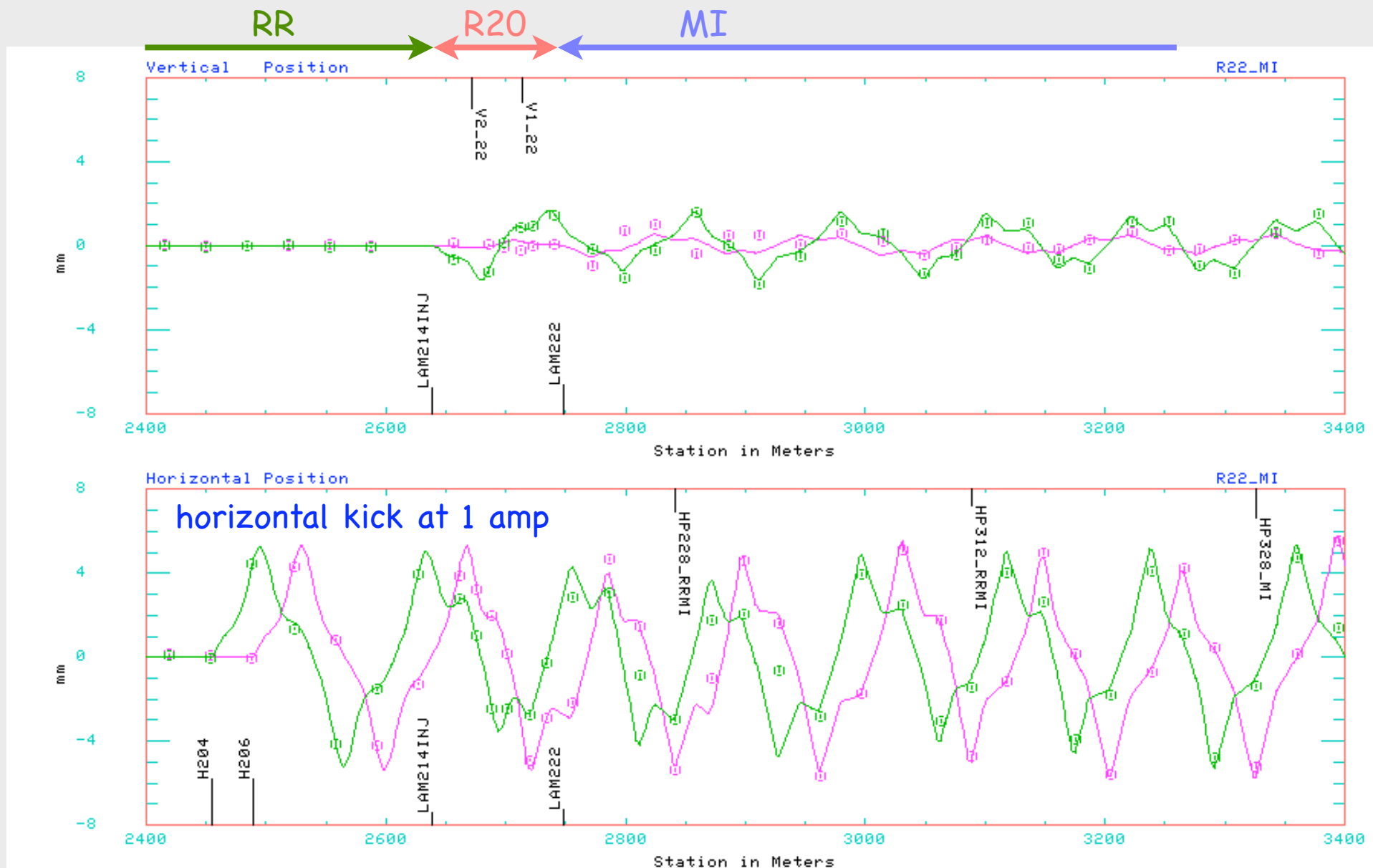
RR20 line setup

Z1 Beam line analysis--Recycler Ring 07-DEC-06 11:44:30 ♦Pgm_Tools♦

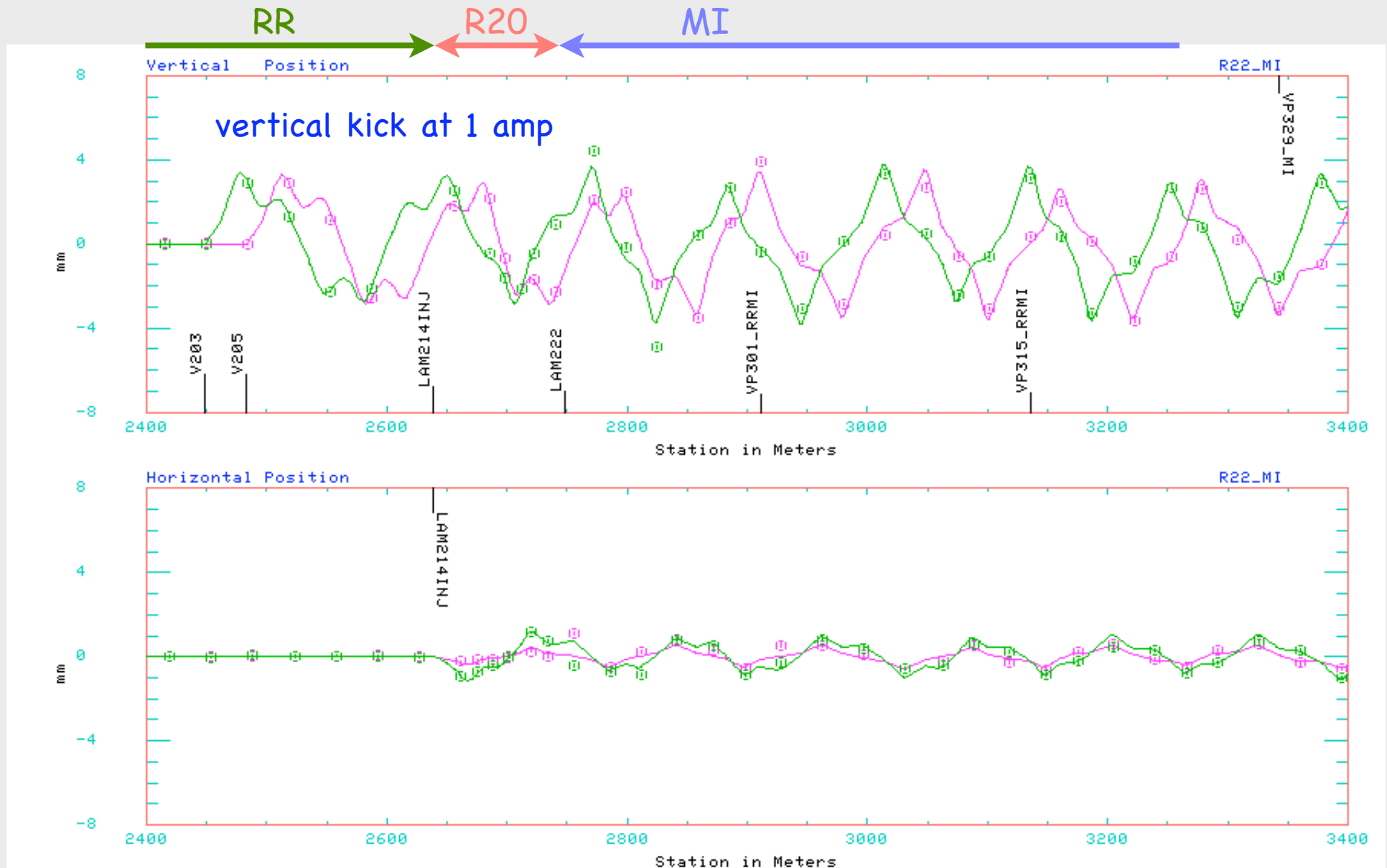
Functions	setup	data	calculate	display	Misc			
Orbit fitting		Lattice parameters						
M	Edit device							
*S	*Device type: [Mult]	*Update: [Manual]			p er plot			
	*Attribute: [Special II]	DB device page						
*	*Mode: [Modify]	*Page length: [25]	*History depth:[15]					
	Multipole	Bend_Roll	Quad_roll	DB_name	Setting	prev_set	reading	prev_read
	ARCDM707A	0	0	R_S214PM	KGMM	199.607	199.607	
	ARCGF706B	0	0	R_S215PM	KGMM	-325.354	-325.354	
	GF706A	0	0	R_S327PM	KGMM	-326.54	-326.54	
R	GD705B	0	0	LAM214K1	AMPS	0	1	.8
	GD705A	0	0	LAM214K2	Amps	0	0	
*D	GF704B	0	0	B1VDPA2	KG/M	0	1	-1
*U	GF704A	0	0	B2VDPA2	KG/M	0	0	
	GD703B	0	0	B1VDPA1	KG/M	0	0	2
B	GD703A	0	0	B2VDPA1	KG/M	0	0	
*C	GF702B	0	0	LAM222K1	Amps	0	.3	.5
V	S227_MI	0	0	LAM222K2	Amps	0	0	
S	S228_MI	0	0					
	S313_MI	0	0					
*A	S314_MI	0	0					
*P	LAM402FF	0	0	R22_QF	AMPS	26.27059	26.27059	
	LAM402SHM	0	0	R22_QD	AMPS	-25.31878	-26.31878	-25.31878
De	LAM328FF	0	0	QDGF_UPS		0	0	
	LAM328SHM	0	0	QDGD_UPS		0	0	
	LAM214FF	0	0					
	LAM214SHM	0	0					
	LAM214INJ	0	-35					
	LAM321CIR	0	0					
<	LAM222EXT	0	40	<Exit>		4:25 of 25		
DB	VDPA2	0	10	0	0	0		
DB	VDPA1	0	0	0	0	0		
DB	<Exit>			403:427 of 427				

1: 3 of 11

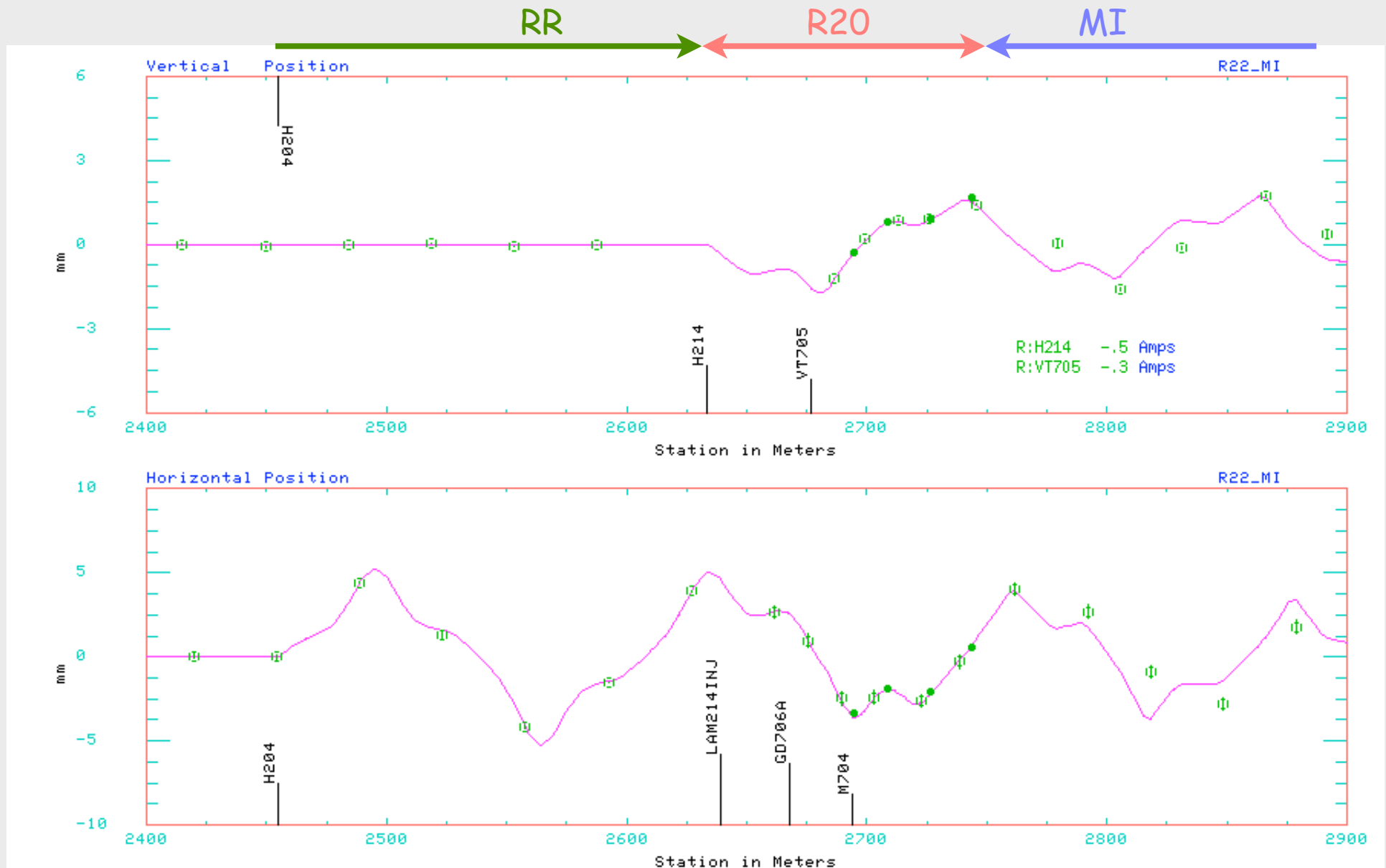
1st order orbit to MI, mm/amp



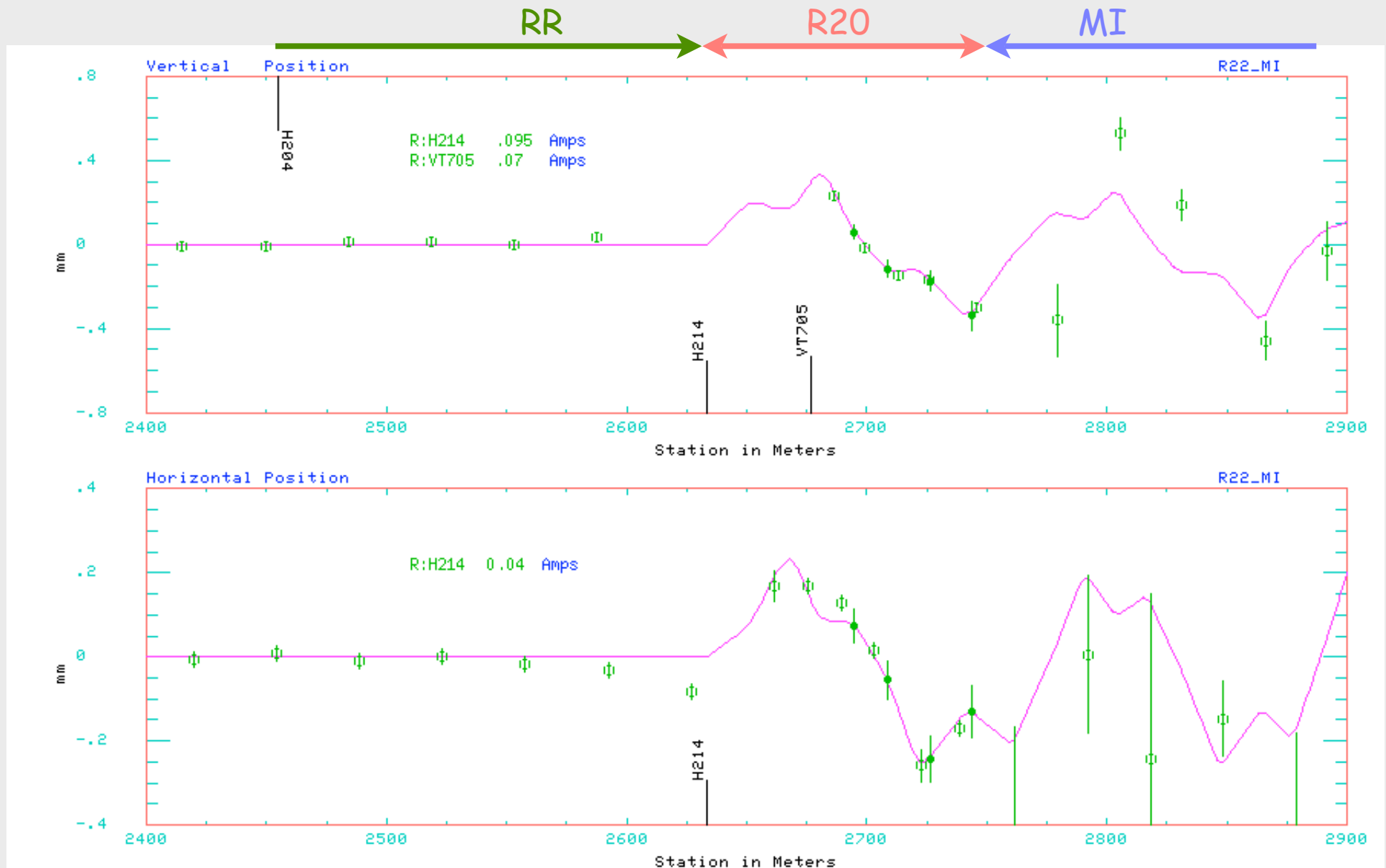
First order orbit to MI, vertical kick



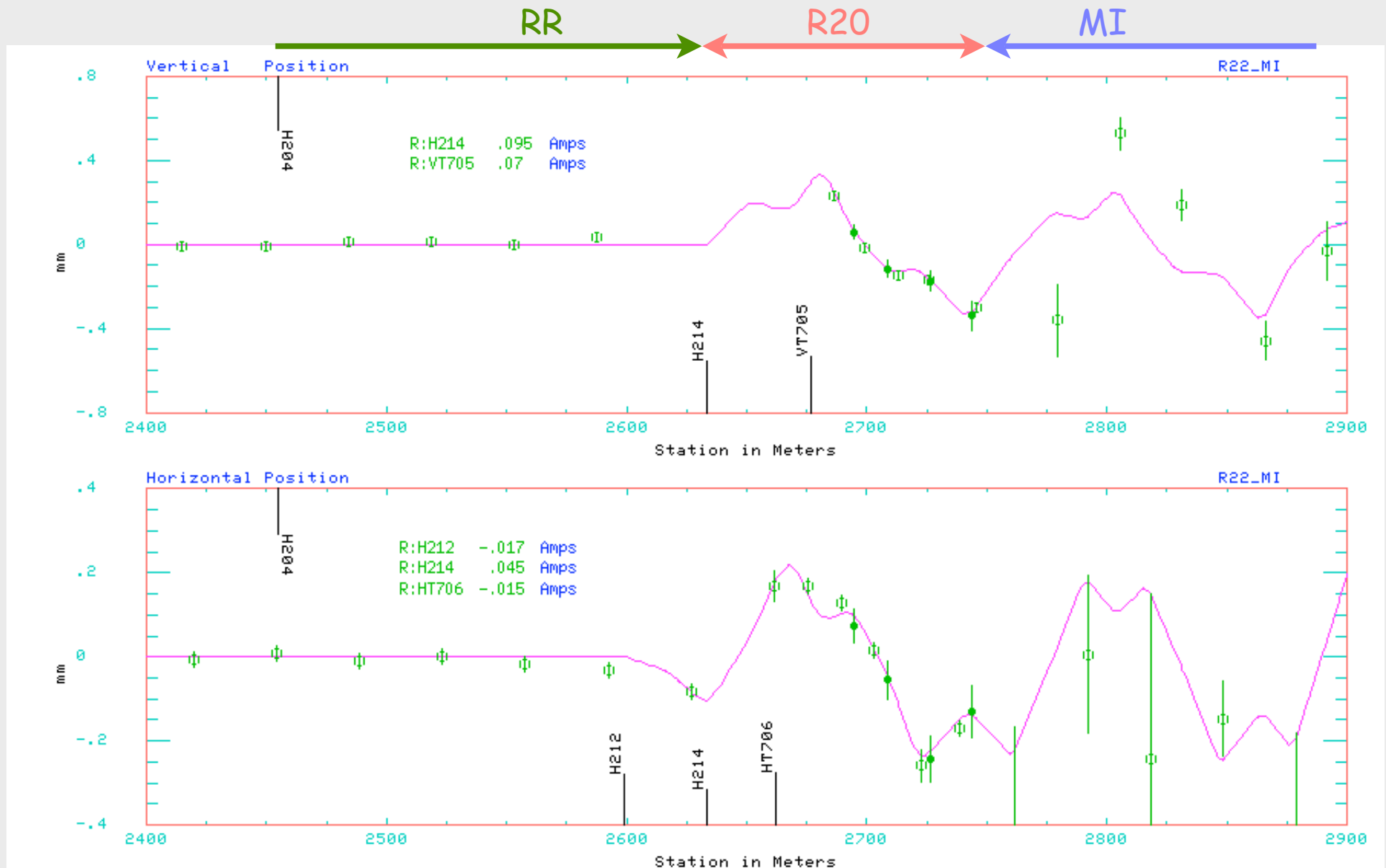
H204 First order orbit, mm/amp



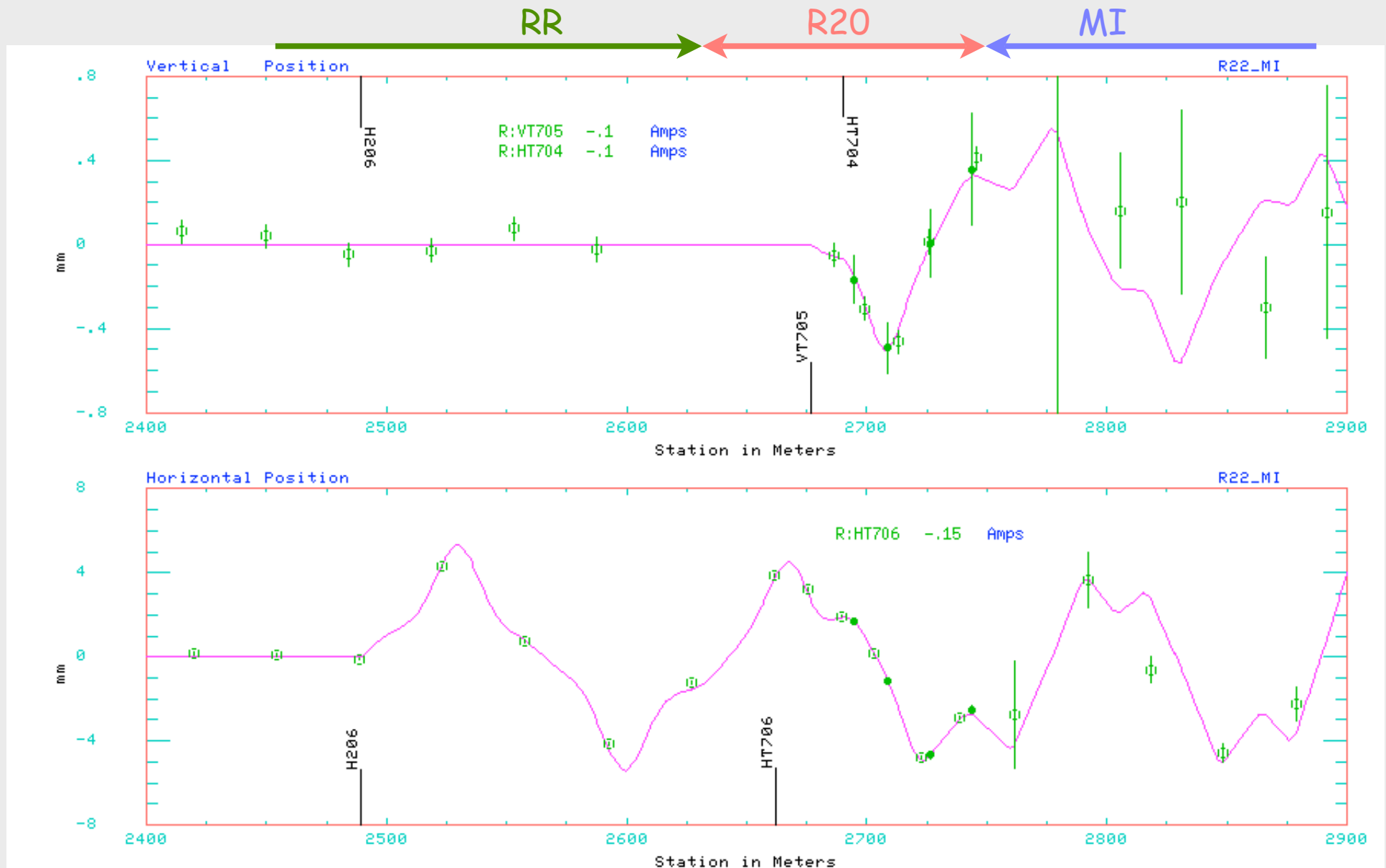
H204 2nd order, mm/amp² - (option 1)



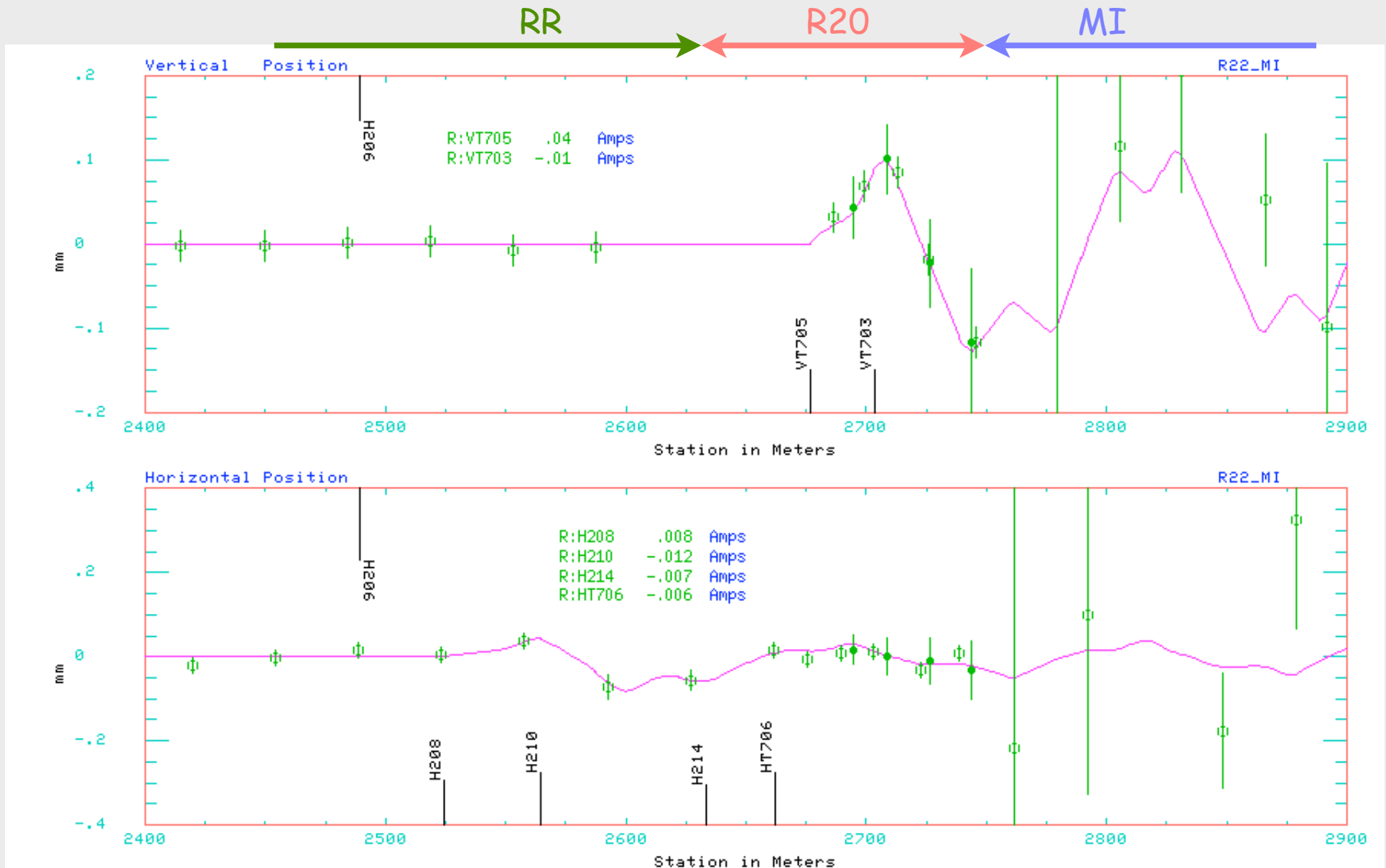
H204 2nd order, mm/amp² - (option 2)



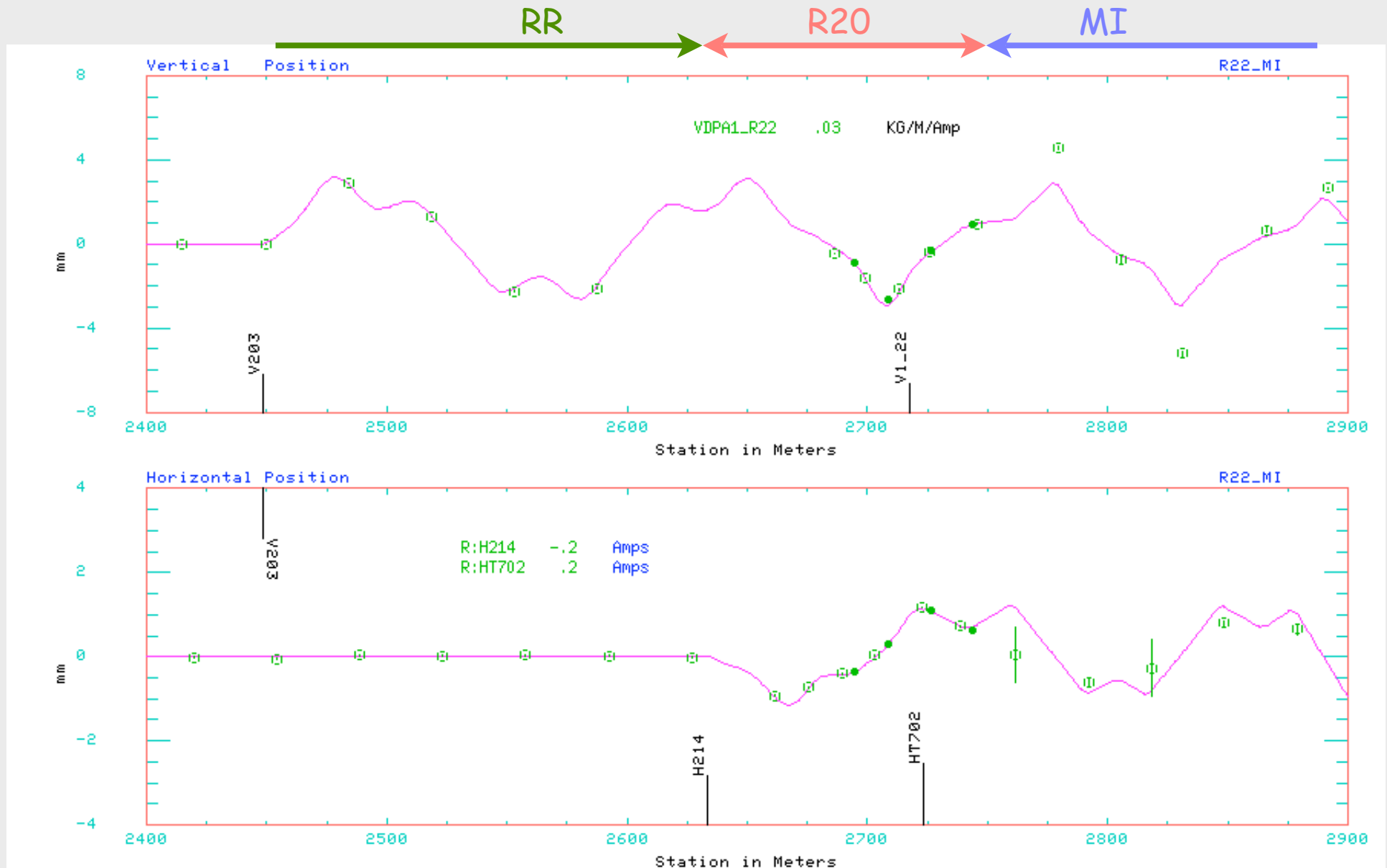
H206 1st order, mm/amp



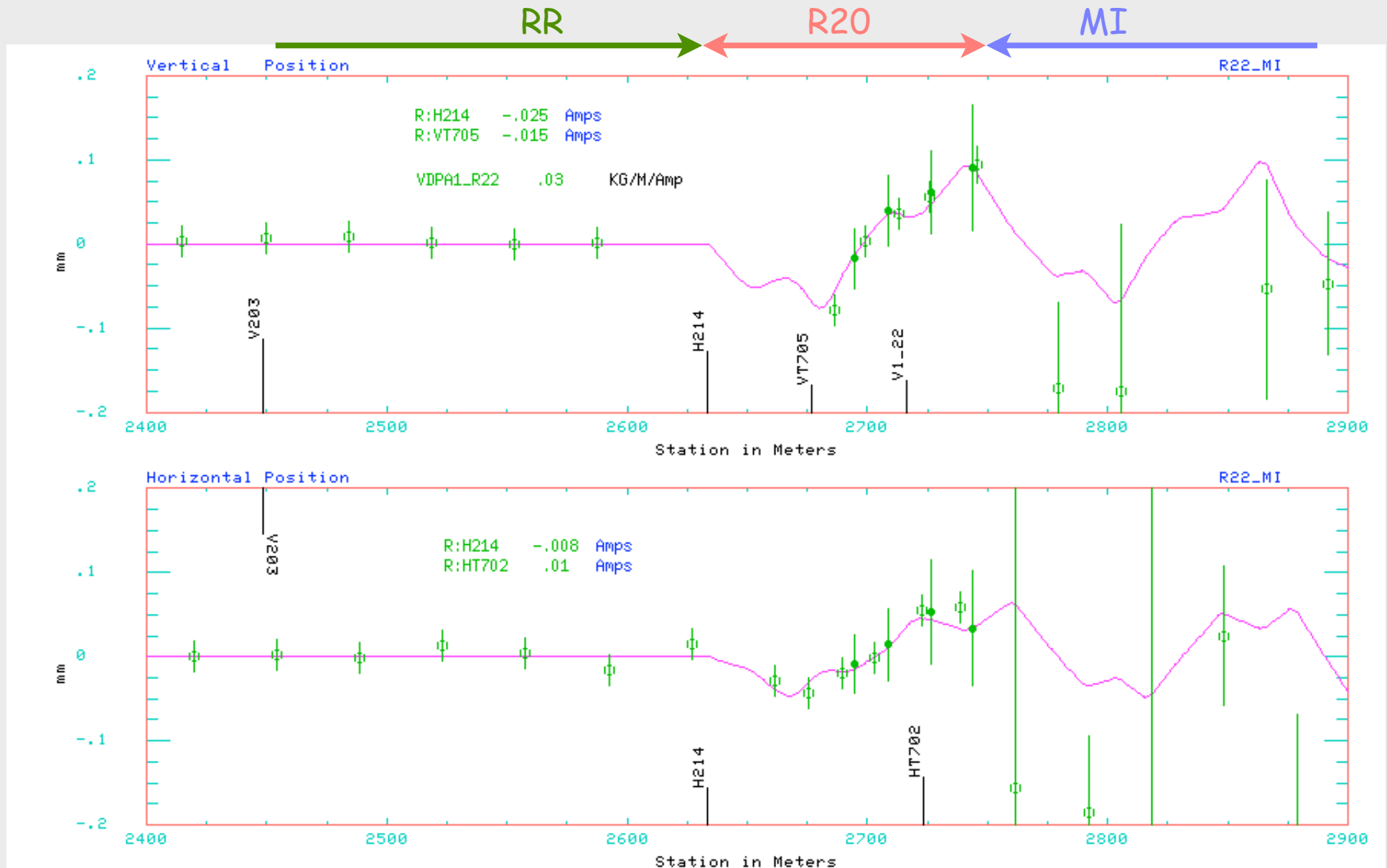
H206 2nd order, mm/amp²



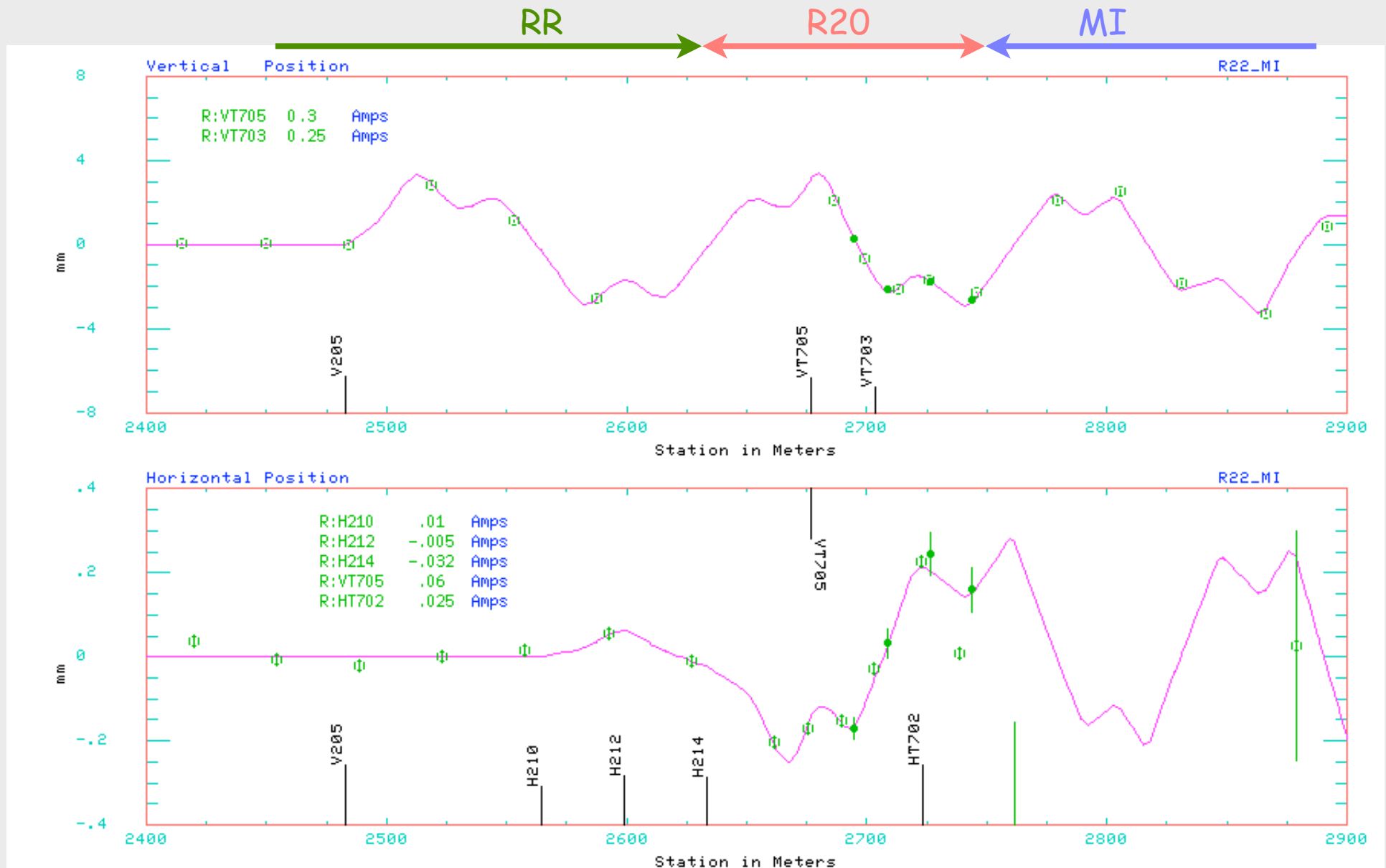
V203 1st order, mm/amp



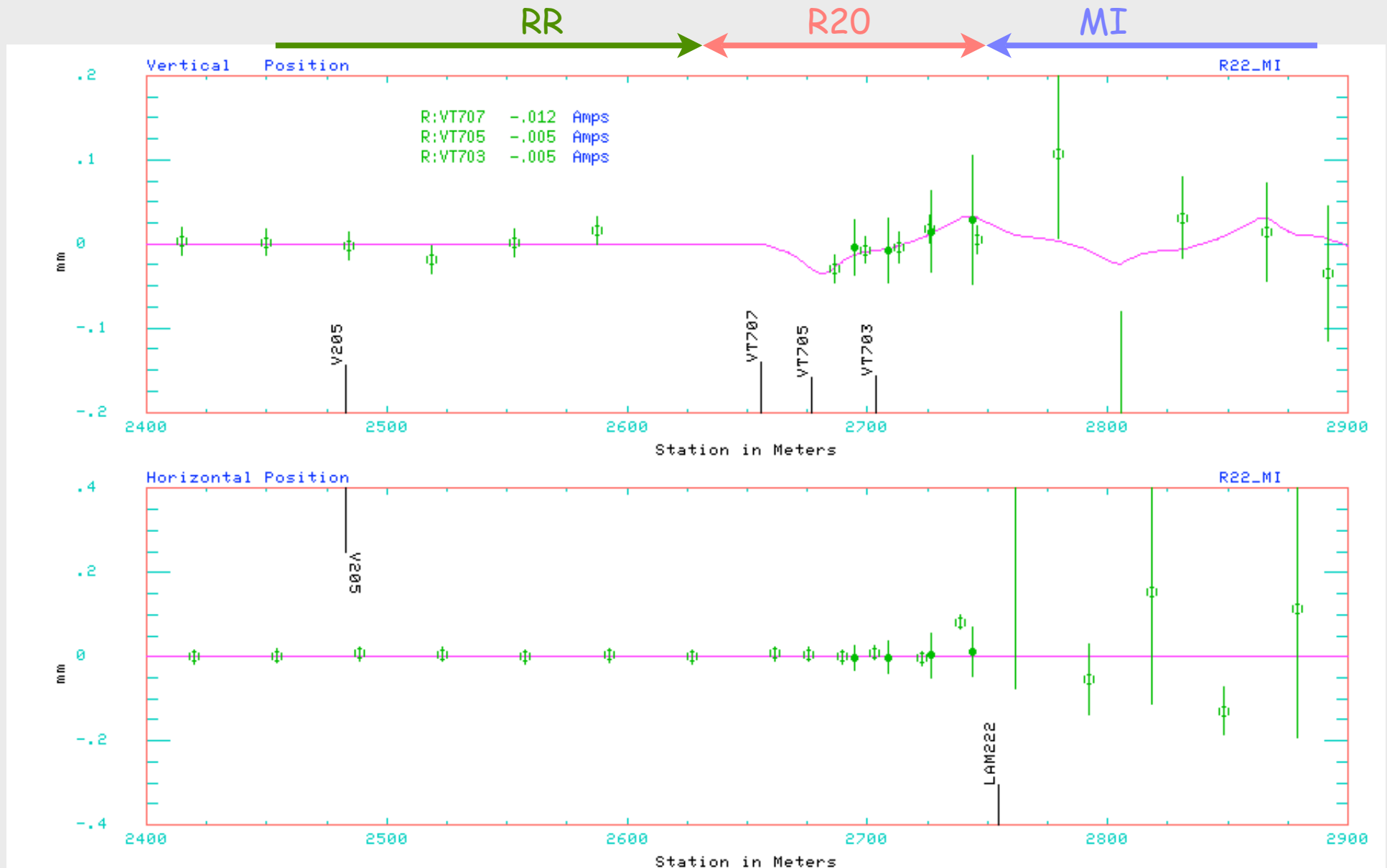
V203 2nd order orbit, mm/amp²



V205 1st order, mm/amp



V205 2nd order, mm/amp²



Estimating field errors in LAM214

❖ Using only H204 data set

- ▶ Length of LAM214:
 - 4.064 m
- ▶ Displacement at LAM214:
 - 4.54 mm @1amp

H214	Kick, amps	Field, $G\text{-}M$	multipole	unit	formula
S. Quad	-0.5	-17.37	-0.94	KG/M	$B_x = A_1 \Delta x$
N. Sext.	0.04	1.39	29.8	KG/M^2	$B_y = \frac{1}{2} B_2 \Delta x^2$
S. Sext.	0.095	3.3	70.7	KG/M^2	$B_x = \frac{1}{2} A_2 \Delta x^2$

Mapping Lam22 error fields

- ❖ Reverse proton study
 - ▶ MI BPM system at 2.5 MHz mode
 - ▶ Study time.
- ❖ Take data during regular Pbar transfer
 - ▶ Turn off SQ703 and SQ704.
 - Simplify analysis.
 - ▶ Use 304 kicker
 - Need kicker strength calibration.
 - ▶ Multiple steps at 2mm each.
 - Kicker non-linearity is an issue.
 - May need MI bpm to quantify kick size.

Conclusion

❖ Optics

- ▶ Linear optics
 - Close to design.
- ▶ Field errors
 - Linear and second order errors.
 - Normal and skew components.
 - Lam214 field error is documented.
 - Other locations

❖ Lattice matching

- ▶ Pending field measurement of Lam222 in MI.

❖ Dispersion function

- ▶ From RR to MI.
- ▶ Waiting for opportunity to take data.